Title: Six Leg Symmetry

Brief Overview:

This unit is designed to provide second and third grade students with hands on experiences using pattern blocks to create symmetrical insect shapes. The concepts of symmetry, spatial relationships, reflection, flips, and slides are included. Internet sites and extension activities are provided to allow for adaptation and enrichment of geometric concepts.

Links to NCTM Standards:

- **Mathematics as Problem Solving**
  Students will demonstrate their ability to solve problems in mathematics including problems with open-ended answers, problems which are solved in a cooperative atmosphere, and problems which are solved with pattern blocks.

- **Mathematics as Communication**
  Students will demonstrate their ability to communicate mathematically. They will read, write, and discuss mathematics with language and terms of the discipline.

- **Mathematics as Reasoning**
  Students will demonstrate their ability to reason mathematically. They will make conjectures, gather evidence, and build arguments.

- **Mathematical Connections**
  Students will demonstrate their ability to connect mathematics topics within a discipline and with other disciplines.

- **Geometry and Spatial Sense**
  Students will demonstrate their ability to apply geometric relationships using two dimensional objects. They will demonstrate symmetry, similarity, and reflection and apply these concepts to the solution of geometric problems.

- **Patterns and Relationships**
  Students will demonstrate their ability to recognize geometric relationships and will generalize a relationship from data.

Grade/Level:

Grades Two/Three

Duration:

Five (sixty minute) periods

Prerequisite Knowledge:

Students should have working knowledge of the following skills:

- Recognizing pattern block shape names (hexagon, trapezoid, parallelogram, triangle, square, rhombus)
- Identifying insects and their body parts (head, thorax, abdomen, 6 legs, antennae, and 0, 1, or 2 pairs of wings)

Objectives:

Students will:

- identify lines of symmetry in a variety of objects.
- construct symmetrical designs.
- construct reflections of objects.
- describe characteristics of combining 2-D shapes.
- describe designs using mathematical language.

Materials/Resources/Printed Materials:

- Pattern blocks
- Overhead pattern blocks
- Resource Sheets #1-5
- The Very Hungry Caterpillar, by Eric Carle, Philomel Books

Development/Procedures:

Day 1:

- Display Resource Sheet 1. Have the students identify the characteristics of an insect: body parts, patterns, symmetry.
- Develop the concept of symmetry using pattern block problems using Resource Sheet 2, problems 1 and 2.
- Develop the concept of shape combinations and replacements using Resource Sheet 2, problem 3.
- Have the students identify lines of symmetry on various pictures of insects using Resource Sheet 3.

Day 2:

- Read The Very Hungry Caterpillar.
- Reread the story, directing students to look for symmetrical objects.
- Have the students examine pictures of butterflies to identify lines of symmetry.
- Have students to translate pictures of butterflies into symmetrical pattern block designs.
- Discuss vocabulary used when describing designs (shape names, flips, slides, turns, above, below, next to, etc.)
- Have students create a simple symmetrical design with blocks and describe it to a partner who can't see the design. Have students construct the designs described.

Day 3:

- Provide pairs of students with two copies of Resource Sheet 1. Have the students cut one picture along its line of symmetry. Have the students place a mirror directly on the cut line of symmetry to illustrate the relationship between reflections and symmetry by comparing the reflection to the whole picture of the insect.
- Have the students describe similarities and differences of insect halves and their reflections with a partner. Similarities should include patterns, colors, and shapes. Differences discussed should include terms such as flips and slides.
- Create a simple design using 4 or 5 overhead pattern blocks. Invite a pair of students to construct its reflection on the overhead.
- Have the students create a simple designs of their own and then have their partner construct reflections.

Performance Assessment:

Scoring Tool:
This response demonstrates the ability to create symmetrical form, identify shapes, and identify shape substitutions:

3 places pattern blocks using precise symmetrical form.
includes all five insect body parts.
identifies all geometric shapes.
identifies three possible shape substitutions used to make the head.

2 places pattern blocks with few errors of symmetry.
includes at least four insect body parts.
identifies most geometric shapes.
identifies two possible shape substitutions used to make the head.

1 places pattern blocks with many errors of symmetry.
includes at least three insect body parts.
identifies some geometric shapes.
identifies one possible shape substitution used to make the head.

0 not scored/off task; did not place pattern blocks with evidence of symmetry.
not scored/off task; did not include at least three insect body parts.
not scored/off task; did not identify geometric shapes.
not scored/off task; did not identify any possible shape substitutions.

The above scoring tool can be used as a holistic tool by giving the overall performance a 3, 2, 1, or 0. The recommended use of this tool is the analytic format which allows a score point to be given for each of the criteria listed. For example, a response may earn a score point three for symmetrical form; a score point two for including body parts; a score point one for identifying geometric shapes; a score point zero for identifying shape substitution. The overall score for such a response would be 6/12. A sample response earning a 12/12 has been provided on Resource Sheet 4.

Extension/Follow Up:

- Visit websites with class to find projects and examine geometry in the real world.
  http://www.eduplace.com/math/index.html
  http://www.jwindow.net/OLD/KIDS/SCHOOL/ART/
  http://www.coolmath.com/netkids.htm
  http://lcs.www.media.mit.edu/groups/el/projects/EW/start.html
  http://mirrors.org.sg/mathforum/dr.math/
  http://www.cuisenaire.com/

- Have the students use Resource Sheet 5 and locate an equilateral triangle that has a length of 5 small triangles. Direct students to use pattern blocks and tally marks to find as many triangles as they can within the larger triangle. Hint: triangles are of many sizes and orientations. There are at least 40 triangles!

- Have the students describe designs using other manipulatives such as geoboards, linker cubes, and tangrams to students that cannot see the design. Have the students construct designs as they are described.

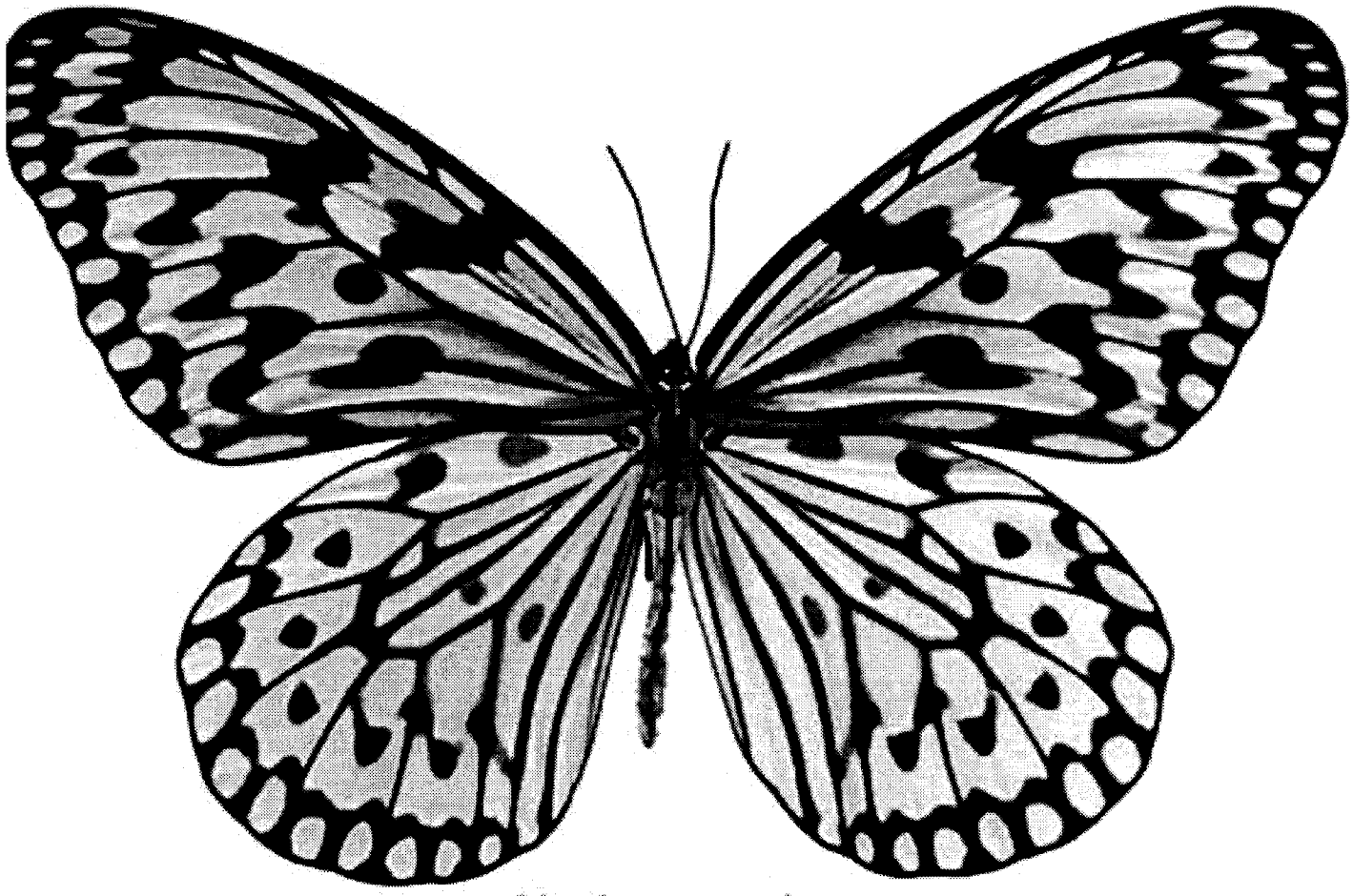
- Have the students construct half of a design on the computer using a draw program and direct partners to construct the reflection using copy, paste, and flip commands.

- Have the students create a pattern block design and trace the outline. Have the students fill the same outline using more blocks and less blocks. Allow students to create challenge center cards of their design with directions such as, "Fill my design with 13 pattern blocks and record it on a piece of paper." Have the students Check the responses for their cards.

Authors:

Laura Cline
Eldersburg Elementary
Carroll County, MD

Lori McCusker
OEE/ESS
Baltimore County, MD



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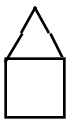
Lines of Symmetry/Shape Substitution

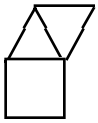
Use overhead pattern blocks to demonstrate and provide students with pattern blocks to create the figures independently. When adding blocks be sure that the entire side of the block touches another. Blocks can be rearranged as more are added.

Figure One:
Begin with an orange square.

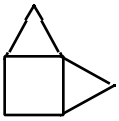


- add one green triangle to create a figure with one line of symmetry

- add one more green triangle to create a figure with
  - no lines of symmetry

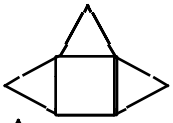


  - one line of symmetry



  - two lines of symmetry

- add one more green triangle to create a figure with one line of symmetry



- add one more green triangle to create a figure with four lines of symmetry.

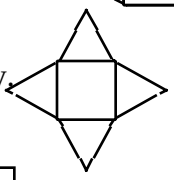
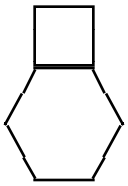
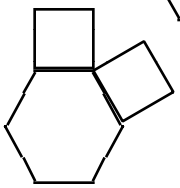


Figure Two:
Begin with a yellow hexagon.

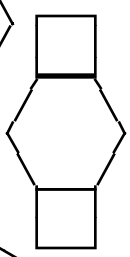


- add one orange square to create a figure with one line of symmetry

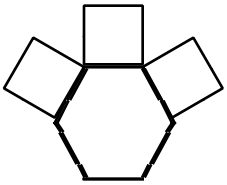
- add one more orange square to create a figure with
  - one line of symmetry



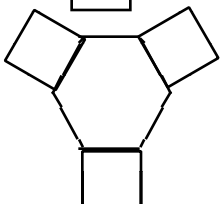
  - two lines of symmetry



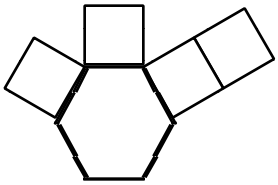
- add one more orange square to create a figure with
  - one line of symmetry



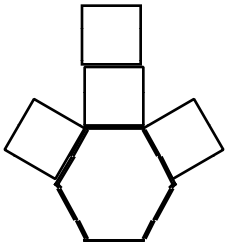
  - three lines of symmetry



- add one more orange square to create a figure with
  - no lines of symmetry



  - one line of symmetry



  - two lines of symmetry

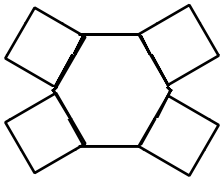
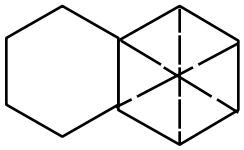
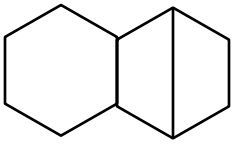


Figure Three
Begin with one yellow hexagon.

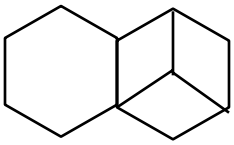
- add six green triangles to create a figure with a line of symmetry that falls on one of the edges of the yellow hexagon



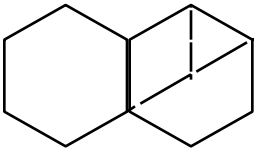
- replace the green triangles using only red trapezoids



- replace the red trapezoids using only blue rhombi

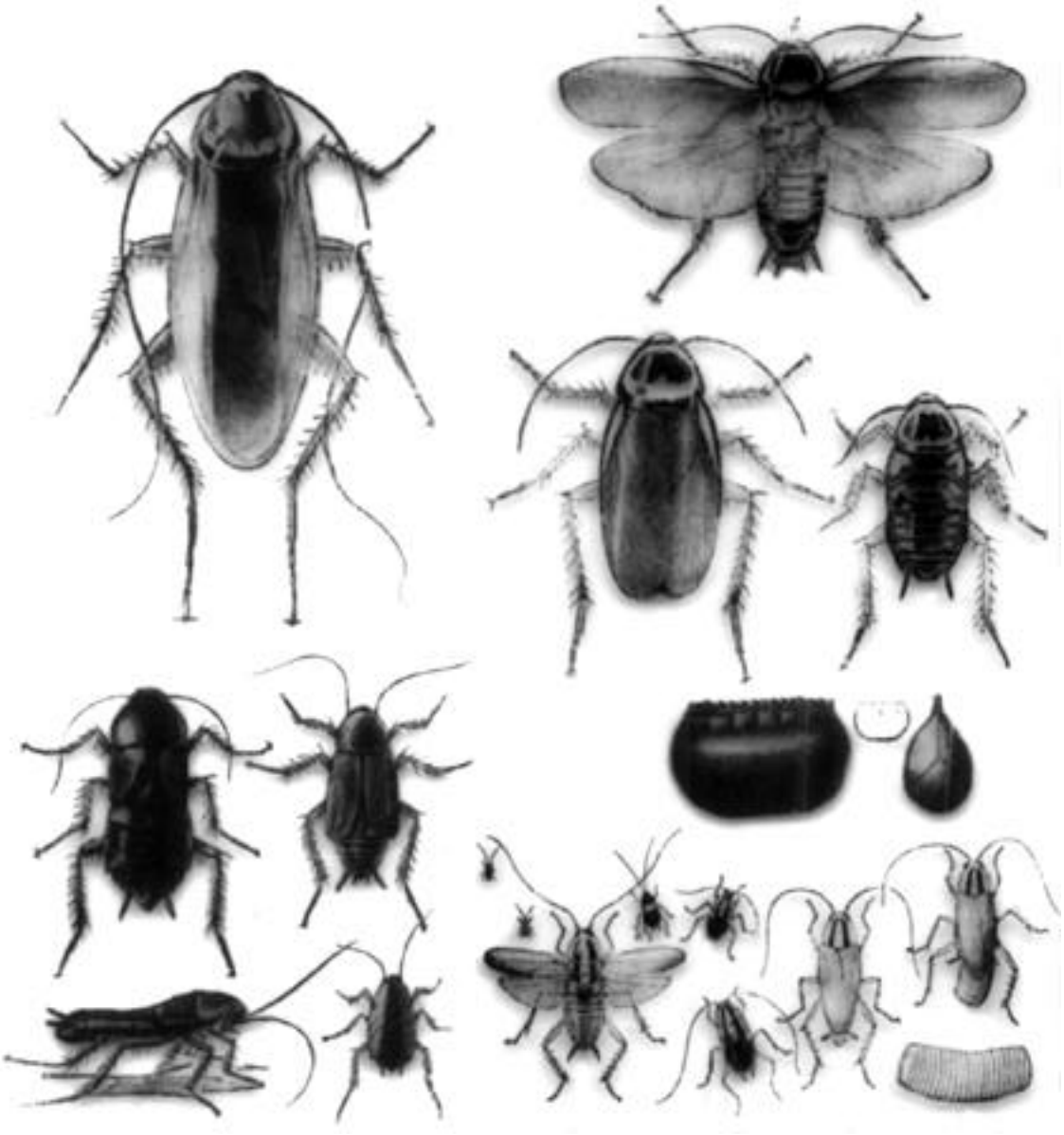


- replace two of the blue rhombi using one red trapezoid and one green triangle.



Six Leg Symmetry
Resource Sheet 3

Do all of these insects have a line of symmetry? Prove your answer.



Share the following scenario with students:

We will be creating an insect quilt to share with another class. Our class quilt will contain pictures of insects created with pattern blocks. Each insect should include all of the body parts and be symmetrical. Create your insect with a pattern and trace it on the back of this paper. List the geometric shapes used for each body part.

List the shapes you used to make the head:

_____
_____
_____
_____
_____

What are three other ways that you could construct the same head with different blocks?

_____
_____
_____
_____
_____

Sample Response

Insect: Bee

Head: 1 hexagon

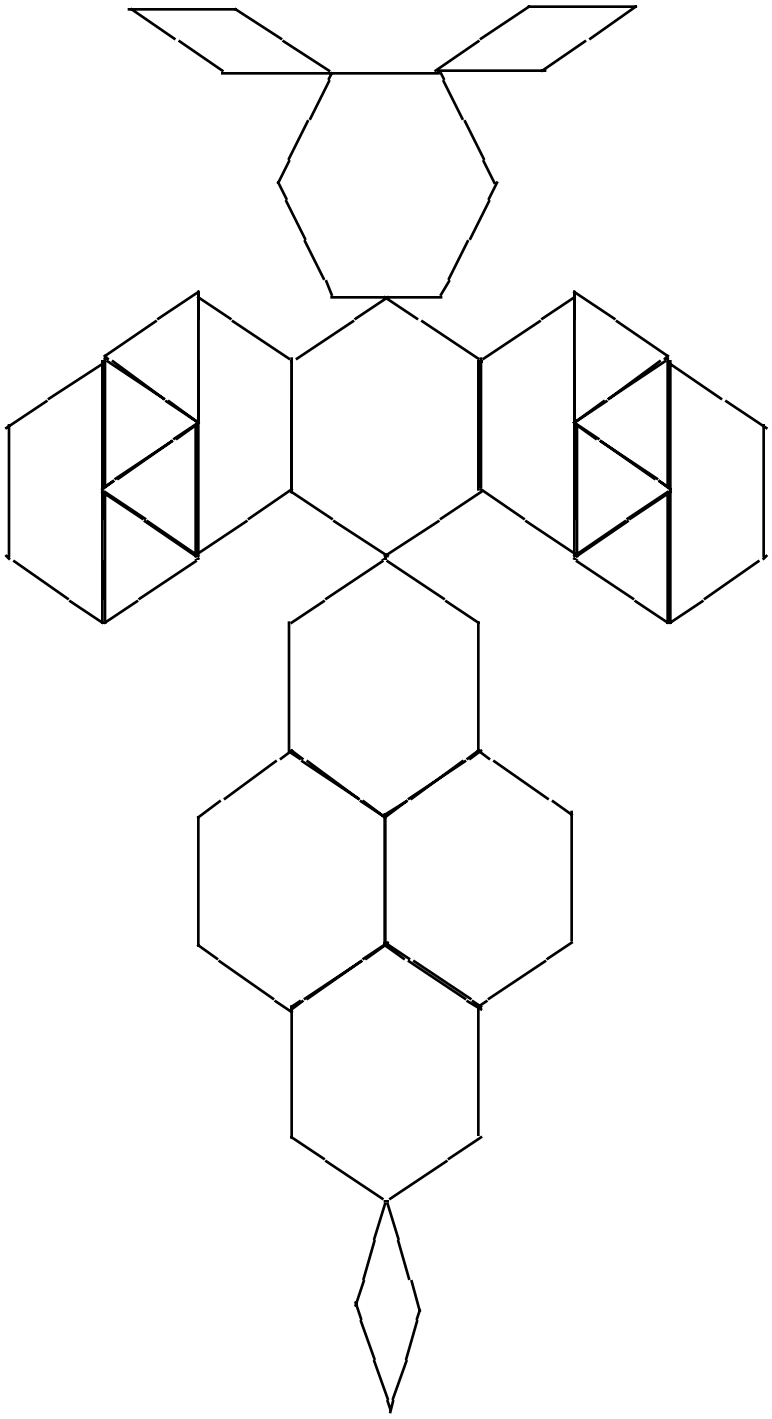
Thorax: 1 hexagon

Abdomen: 4 hexagons
(1 trapezoid - stinger)

Legs: hidden

Antennae:
2 parallelogram

Wings:
4 trapezoid
8 triangles



Hexagons can be created using six triangles; two trapezoids; three rhombi; one trapezoid, one triangle, one rhombus; one trapezoid, three triangles; one rhombus, four triangles; or two rhombi, two triangles. *Trapezoids* can be created using three triangles; or one rhombus, one triangle. *Rhombi* can be created using two triangles. *Squares* and *parallelograms* can not be created using other pattern blocks.

Pattern Block Triangle Paper